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PSYCHE

A JOURNAL OF ENTOMOLOGY

ESTABLISHED IN 1874

Vol. 63 December, 1956 No. 4

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PSYCHE is published quarterly, the issues appearing in March, June, September, and December. Subscription price, per year, payable in advance: $3.00 to subscribers in the United States and Canada; other subscriptions $3.35. Single copies, 85 cents.

Cheques and remittances should be addressed to Treasurer, Cambridge Entomological Club, Biological Laboratories, Harvard University, Cambridge, Mass.

Orders for back volumes, missing numbers, notices of change of address, etc., should be sent to the Editorial Office of Psyche, Biological Laboratories, Harvard University, Cambridge, Mass.

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The Sept., 1956, PSYCHE (Vol. 63, No. 4) was mailed June 28, 1957

EATON PRESS INC., WATERTOWN, MASS.

PSYCHE

Vol. 63 December, 1956 No. 4

THE INDO-AUSTRALIAN SPECIES OF THE ANT GENUS *STRUMIGENYS* FR. SMITH: THREE NEW PHILIPPINE SPECIES[1]

By William L. Brown, Jr.

Museum of Comparative Zoology, Harvard University

This paper is a further contribution in a series which, when complete, will cover the Indo-Australian portion of the world fauna of the dacetine ant genus *Strumigenys* Fr. Smith. Previous parts, the first two of which include explanations of the abbreviations used for citing measurements and indices, are in *Psyche* 60: 85-89 (1953), 60: 160-166 (1954) and 61: 68-73 (1954).

The last reference just cited contains the description of *S. chapmani* Brown, from the Philippines, a species that is very difficult to assign to any species group. There are also known from the same islands a member of the *szalayi* group (*australis* or near); an undescribed species, apparently nearest *S. koningsbergeri* Forel; a member of the "Labidogenys" complex, probably new, and four species of the *godeffroyi* group, including *S. godeffroyi* Mayr and the three forms described here for the first time. This makes a total of eight known *Strumigenys*, which is undoubtedly only a fraction of the number actually to be found in the Philippines.

So far as can be determined from the present samples, the Philippine *Strumigenys* fauna is Indo-Malayan in affinities, with also an element (*australis*) of probable Papuasian

[1] Published with the aid of a grant from the Museum of Comparative Zoology at Harvard College.

origin. As elsewhere in the East Indies, species endemism is high.

Strumigenys esrossi, new species

Holotype worker: TL 2.4, HL 0.62, ML 0.28, WL 0.60; CI 72, MI 45.

Head and mandibles in general form much like those of *godeffroyi*; the occipital lobes with a feeble indication of dorsal depression and another extremely feeble depression in the center of the cephalic dorsum at eye level. Mandibles only very feebly arcuate; dorsal tooth of apical fork nearly twice as long as the ventral; the latter parallel and with two small acute intercalary denticles on its inner margin. Preapical spiniform tooth distant by about 1½ times its own length, situated at approximately the apical third of the length of the shaft, a little more than half as long as the dorsal apical tooth. Alitrunk slender, pronotum depressed, forming a nearly straight gentle slope in profile, continuous with the anterior mesonotum; posterior mesonotum rather strongly and broadly concave, continuous with the very feebly convex propodeal dorsum; metanotal groove absent. Propodeal teeth spiniform, but enveloped in infradental lamella, which is acute at their tips and broad and weakly convex below; spongiform tissue not or extremely slightly developed on the lateral faces of the lamellae. Petiolar node long and low, gently rounded above and with a gentle anterior slope. Spongiform tissue reduced to moderate posterolateral flaps and a strong mid-ventral band. Postpetiole moderate in size, nearly twice as broad as petiolar node, convex, finely and densely striolate-punctulate longitudinally, opaque. Anterolateral spongiform appendages less well developed than in *godeffroyi*. Basigastric costulae a broad band of extremely fine, dense longitudinal striolation extending about half the length of the basal tergite, and behind this extending briefly as indefinite traces, although the surface here is generally smooth and shining. Mandibles fairly smooth, shining. Rest of body densely punctulate and opaque, including sides of alitrunk.

Pilosity consisting, except for a few short clavate hairs

at the gastric apex, entirely of short, appressed, whitish spatulate hairs, only moderately distinct on the head, where they are largest posteriorly; reduced, few and scarcely visible at all on alitrunk; a few, inconspicuous, on the petiolar and postpetiolar nodes. Hairs on scape border slender spatulate, subappressed and directed toward the scape apex. Gastric dorsum with very indistinct, small, fine appressed hairs, (color sordid yellowish ferruginous; dorsum of head feebly darkened in the middle.

Holotype [California Academy of Sciences] one of 21 workers taken at San José, Mindoro I., Philippine Islands, from a nest in a small cavity in the soil, 3 inches below the surface (E. S. Ross leg.).

Paratype workers: 20 workers from type nest series; numerous workers from near Dumaguete, Negros Oriental, Philippines (probably chiefly from the Cuernos Mts.) (J. W. Chapman and D. Empeso); one worker from MCZ miscellany. Victoria, Luzon (Pierce leg.); one worker from Jolo I., Philippines, from stomach of *Rana microdisca leytensis* in MCZ. TL 2.2-2.7, HL 0.58-0.65, ML 0.26-0.30, WL 0.58-0.68; CI 70-74, MI 45-46. The larger workers are often lighter and more yellow in color. Paratypes in CAS, USNM, MCZ.

Female, from type nest series: TL 2.8, HL 0.67, ML 0.29, WL 0.69; CI 75, MI 43. Mesonotum with a feeble median sulcus; pilosity as on head, except for a pair of short, tapered, erect hairs on anterior scutum. Nodes broader than in worker; petiolar node about as broad as long. Gaster more opaque, the striolae stronger and extending nearly the whole length of the basal tergite; coarser at extreme base. Anterior gastric dorsum with a widely spaced pair of very small erect clavate hairs. Medium ferruginous; ocelli small, with blackened callus at each. Male unknown.

This species is so far known only from the Philippines, where it is widespread and apparently rather common. It combines features of the *godeffroyi* and *szalayi* groups, but seems best placed with the former group. It is strongly distinct in sculpture and pilosity. From *S. phytibia* sp. nov., another Philippine species with striate pospetiole, *S. esrossi* differs in the more proximally placed preapical tooth,

the slightly more arcuate mandibles, different pilosity, and other details.

Strumigenys uichancoi, new species

Holotype worker: TL 2.2, HL 0.55, ML 0.26, WL 0.53; CI 72, MI 47. Shape of head, mandibles and antennae very much as in *S. frivaldszki* as figured by Emery in his original characterization of that species. The mandibles are slender, and the preapical tooth is straighter, and is placed slightly farther from the apical teeth, at or a little basad of the apical quarter of the ML. Promesonotum weakly convex, posterior mesonotum very weakly depressed (less so than in *godeffroyi*) and in profile forming an uninterrupted straight or extremely feebly convex dorsal outline with the propodeum. Metanotal groove completely obsolete on the dorsum. Propodeal lamellae moderate in size, with short upper teeth, each embedded in fairly thick lamelliform angles, so that the upper corners of the lamellae are obtuse; below this, the lamellae gradually widen ventrad (to nearly twice the dorsal width at the position of the teeth) and are here convex. The lamellae are smaller and narrower above, and without definite development of spongiform tissue on their lateral faces, but otherwise similar to those of *godeffroyi*. Petiolar node a little longer than broad, subglobose, with moderately steeply sloping anterior face; broadly rounded above as seen from the side. Lateral spongiform lobes much narrower and less well developed than in *godeffroyi*, anterior nodal face not nearly so steep. Postpetiolar disc small, convex, smooth and shining.

Sculpture of alitrunk weak, entirely effaced on the sides, which are consequently smooth and shining, and almost gone on much of the pronotum, which is moderately to fairly strongly shining. Petiole opaque. Basal gastric costulae few (11-12), extending 1/5 or less the length of gastric tergite I, well separated and irregular in length. Rest of gaster smooth and shining.

Pilosity consisting of short, very fine hairs, feebly subspatulate and appressed or subappressed on the anterior part of the cephalic dorsum and the anterior scape borders, erect and quite abundant on the posterior half of the head,

finer, erect and sparse on the alitrunk, nodes and gaster. A few hairs are slightly longer: on humeral angles, mesonotum, and gastric dorsum, appearing flagellate, but the tips looped back on the shafts to suggest a false spatulate condition in the present specimen.

Holotype a unique [USNM] taken in U. S. Plant Quarantine (No 686, 10385) at Honolulu from a fern plant originating in the Philippine Islands. Closely related to *godeffroyi,* but differing in smaller size, pilosity and placement of the preapical tooth, among other characters.

Strumigenys phytibia, new species

Holotype worker: TL 2.5, HL 0.60, ML 0.29, WL 0.65; CI 69, MI 48. Closely resembles *godeffroyi,* with straight mandibles and slightly recurved preapical tooth set less than its own length away from the dorsal apical tooth. Clypeus with anterior border only extremely feebly concave, almost straight. Posterior mesonotum gently concave. Propodeal teeth acute and elevated, but each is encumbered in a thin, areolate infradental lamella which becomes broadly convex below, the lamellae with a few barely perceptible strands of spongiform tissue on their lateral faces. Petiolar node subcircular seen from above, broadly rounded above and with steeply sloping anterior face as seen from the side. Postpetiolar disc convex, broader than long, its surface completely, distinctly and regularly longitudinally costulate and opaque.

Gaster with rather coarse basal costulae interspersed with fine parallel striation extending to about the midlength of the first segment; remainder of gastric surface smooth and shining. Pronotum very indistinctly substriate over punctulation in a longitudinal direction, definitely opaque. Head, alitrunk, legs and petiole densely punctulate, opaque; fore coxae and a ventral strip along mesopleura smooth and shining.

Pilosity of alitrunk similar in plan to that of *godeffroyi,* but much reduced, the hairs smaller, fewer and more nearly appressed. Humeral and mesonotal paired flagellate hairs extremely fine, as are also the lateral and posterior occipi-

tals. Ground pilosity of head abundant, extremely fine and inconspicuous, appressed or nearly so and directed anteriorly and medially. A half dozen or fewer weak erect flagellate hairs on the gastric dorsum. Spongiform appendages covering less than half the sides of the nodes, generally less well developed than in *godeffroyi*.

Holotype taken in U. S. Plant Quarantine at Honolulu (No. 8807) from plants of *Grammatophyllum multiflorum* originating in the Philippine Islands; deposited in USNM.

Paratypes: Three workers with the same data as for holotype do not vary in measurements by much more than the usual maximum error. CI 67-68, MI 48-49. [USNM, MCZ.]

Alate female paratype, same data as for holotype: TL 2.7, HL 0.62, ML 0.28, WL 0.72; CI 74, MI 45. Like worker, with usual caste differences. Mesonotum evenly and densely punctulate, no costulae or median sulcus; mesepisterna and fore coxae shining. Petiolar node broader than long. Forewing with only R+Sc, stigma and 2r well defined; basalis oblique, indistinct; M+CuA and CuA indistinct, some other veins indicated by weak creases. Forewing L ca. 2.0 mm.

THE COLLEMBOLA OF LEBANON AND WESTERN SYRIA. PART I.

GENERAL CONSIDERATIONS AND THE FAMILY ONYCHIURIDAE

By K. Christiansen
Grinnell College, Grinnell, Iowa

The Collembolan fauna of the eastern end of the Mediterranean is still very poorly known. Brown (1926) made the first major contribution by describing twelve species taken by Buxton and Evans in the region of Amara and Baghdad in Iraq. Handschin (1942) recorded all but one of these species from Palestine, and added 26 additional forms. In his recent paper upon the Collembola taken during a speleological expedition in Lebanon, Cassagnau (1951) added 25 new forms to this list. In addition to these major works a number of smaller papers have been published upon new material or further records.

The series of papers, of which this is the first, will constitute a description of over 80 species collected from Lebanon and Western Syria. More than 35 are new to science or new records for the Near East. Collections upon which this study was based were made from over 100 localities including most of the major habitats of the region. Caves were poorly represented, but these have already been extensively investigated by Cassagnau (*op. cit.*).

Acknowledgements

The material described in these papers was collected during my three-year stay at the American University of Beirut, and I wish to thank the staff of that organization for their financial aid and encouragement in the completion of the project. The collecting, handling, and sorting of material was greatly aided by a number of

students, particularly Mr. Raja Asfour and Mr. Muhammed Salaymeh. I particularly wish to thank Dr. H. Gisin for his helpful comments.

Description of Localities

Lebanon and Western Syria comprise an area of extremely variable topography and ecology. The most prominent physical feature of the area under consideration is the Lebanon Mountain Range. This range reaches its highest peak (10,131 ft.) in North Central Lebanon and gradually decreases in height northward. Between these mountains and the sea is a narrow coastal plain which widens from south to north. In Lebanon a second parallel mountain range, the Anti-Lebanon Mountains, marks the Western border of this country. Between these two ranges lies the central valley of the Bekaa, which continues in the North as the North Syrian Plain. The single common ecological factor is that most of the area is greatly impoverished by almost every conceivable type of land overuse. Many of the mountainous areas are largely denuded of soil due to excessive grazing by goats and the resultant erosion. Most of the valley or plains regions suffer from chronic nitrogen and mineral lack, while most of the desert flora is kept in a condition of abnormal dwarf growth by the excessive grazing of the Bedouin flocks. The few nearly natural regions left are largely limited to the rare forests of the larger mountain peaks of Lebanon, the pine forest of Northern Latakia, and the deeper reaches of the desert. Except for the mountain areas, rainfall is completely seasonal, being limited to the winter months. The rainfall varies from 34 inches in Beirut to less than 3 inches in some regions of the Syrian Desert. In both cases most of the rain falls between November 1st and May 1st, and rain in July or August is unheard of. The effect of this is that the Collembola vary in both abundance and occurrence according to areas and seasons. In the more humid areas Collembola are abundant wherever food material occurs in the rainy season. In drier regions they are very rare in most areas. In all parts of the country numerous refugia exist with year-round mois-

ture of a sufficiently high level to support a more or less permanent population. Such refugia occur along the banks of rivers, in the moist beds of dry streams, or the edges of ponds and lakes. Most commonly they are found around the borders of the numerous springs of the mountainous regions. In extreme desert regions only a few xerophilic species can be found far from the limits of these refugia. The swamps or lake shore refugia frequently show an impoverishment of collembolan fauna, possibly due to their periodic inundation. Almost all of the Lebanese and Syrian level arable land is under heavy cultivation. Most of the species occurring in such areas are migrants or agriculture-tolerant forms. On the whole the fauna in this region is impoverished, although an occasional wood lot or hedge-row may be quite rich in some forms.

The lower slopes of the Lebanese Mountains are largely covered by small xerophytic brush and a few strands of hardy grass. Wherever enough soil and enterprise remain, terraces are built and fruit, wheat and other crops are grown. A few planted and more or less carefully parked pine forests exist in a few regions, especially in southern Lebanon. All of these habitats have extremely limited collembolan faunas, although a large percentage of indigenous forms occurs. The richest faunas occur in the high Lebanese Mountains. These areas were probably one time entirely forested, with spruce forests in the northern areas, and cedar in the central and southern regions. At the present time only four forests of any size are left, the remainder of the slopes being kept in a barren rocky condition with poor herb grass-low shrub covering. The existing forests are: a large spruce forest in the Halba region of northern Lebanon; the Hadeth, Ain Zahlte, and Barouk cedar forests in central and southern Lebanon. All of these forests are growing on limestone substrates mostly on or near mountain peaks. The forest soil consists generally of a thin layer of duff, beneath which is a shallow black or gray humus. Below this layer limestone appears, frequently as bedrock. The forests tend to be open, with undergrowth limited to the edges and cleared central valleys. The spruce forest was largely cut

over by the British in 1945, so that only a few large trees remain. Most of this forest land is now clothed with second growth of small spruces and shrubs. The Hadeth cedars are being heavily but sporadically cut at the present time, but the other two forests have been largely uncut for the last twenty years. Most of these forest lands support some fauna in the deeper soil layers, even during the driest seasons.

In addition to the forest regions a large number of steep valleys occur where rain and surface water maintain continuous moist conditions. Such areas usually have a lush mesophytic flora, which is of striking contrast to the barren overgrazed xerophytic vegetation of the surrounding mountains. Such areas have an abundant collembolan fauna and because they are isolated by large stretches of dry, impoverished territory, the fauna of each valley is usually somewhat unique.

A last major habitat type is represented by the Northern Latakian Pine Forest. This large forest is situated directly below the Turkish border and is continuous into Southern Turkey. The area on the whole is similar to the mountain forests of Lebanon except for 1.) the development of a true podsol, and 2.) the existence of isolated patches of beech-oak mesophytic forest. These last areas have probably the richest collembolan faunas of any region of the Near East with many forms being represented from these areas only. These patches of deciduous forest occur apparently only at regions of excessive ground water and remain humid during most of the year. In this, and other respects, these patches of mesophytic woods resemble the isolated humid valleys of the high Lebanon Mountains, but are infinitely richer in fauna, possibly due to their existence in the center of the well populated pine woods area.

General Zoogeographical Considerations

The collembolan fauna of this area belongs to four major distribution groups. In order of their representation in the fauna, these are: 1.) Circum-Mediterranean; 2.) Holarctic-Cosmopolitan; 3.) Xerophytic North African

and 4.) Central European. In addition to these there are a number of forms of dubious zoogeographical associations. There are a large number of species (as far as is now known) limited to the area. It is no surprise that the great majority of this last group occurs in the relatively untouched forest areas and deep valley mesophytic regions, while the lowland farm areas show a great preponderance of widespread forms. Determining which forms are indigenous and which have been introduced is made utterly impossible by the antiquity of commerce and agriculture in the area, as well as our lack of knowledge concerning distribution mechanisms in Collembola.

Systematic Portion

Four species of the family Onychiuridae have been previously reported from the region. These are: *Onychiurus fimetarius, O. armatus, O. octopunctatus,* and *Metaphorura bipartita.* In the present paper two of the above are again recorded and six additional species are found: *Stenaphorura quadrispina, Onychiurus ambulans,* and four new species of *Onychiurus.*

Onychiurus levantinus n. sp.

Plate 7, Figures 5-8

Description of holotype (female): Color white; body elongate sub-cylindrical with sixth segment strikingly smaller than remainder; antennae with line between third and fourth segments indistinct; sensory organ of third antennal segment with five protective papillae, a pair of slightly curved rods and a pair of knob-covered oval organs; P.A.O. of 35 closely packed simple lobes in the form of a narrow ellipse; integument uniformly granulate, only slightly coarser on dorsal surface of head than remainder of body.

Following the chaetotaxy system developed by Gisin (1952), the holotype has the following formulae: 1st thoracic segment: i3m; abdominal segment two: M SS 'M'; abdominal segment five: M SS 'M. The relationship between setae M and S of abdominal segment five is 19/12

with the anterior border of the anal horns taken as 10.

The unguis is untoothed with the empodial appendage having a long filiform extension slightly exceeding the apex of the unguis. The anal horns are curved and stout, about as long as the hind unguis. A small but well developed cuticular fold exists in the region of the furcula. Pseudocellar formula: Dorsal surface — 32/022/333420. No pseudocelli seen on ventral surface of animal.

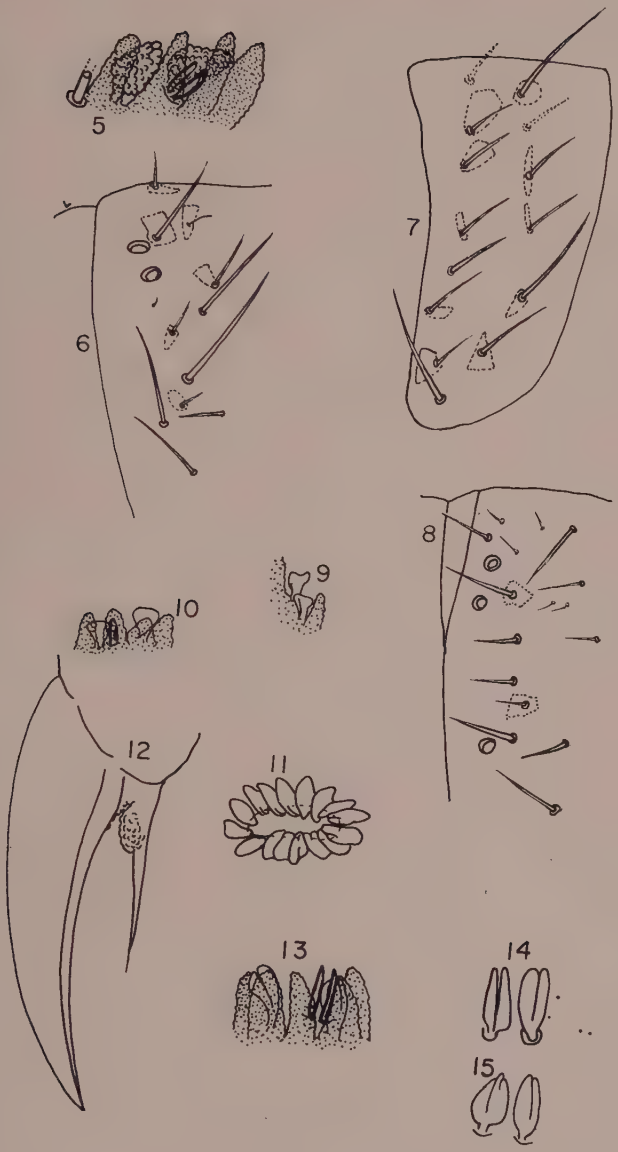
Variation and Discussion.[1] The number of lobes on the P.A.O. varies from 28 to 36, with even smaller numbers occurring on obviously immature specimens. The male specimens never display any special ventral organ. The pseudocelli are constant except for a pair of ventrals appearing occasionally on the head. The lateral pseudocelli on the third thoracic segment, and the lateral posterior pair on the fourth segment, are not always clearly visible, but further examinations have led me to believe that this is a matter of technique and that they are always present. The chaetotaxy of the first thoracic segment varies a

[1] Unless otherwise stated, the variation mentioned in each of these sections is that found in normal specimens of apparent sexual maturity.

Explanation of Plate 7

Figs. 5-8. *Onychiurus levantinus* n. sp. Fig. 5. Third antennal segment organ paratype (male). Organ length 18 micra. Fig. 6*. Posterior border fifth abdominal segment, specimen from "The Cedars," Lebanon. Side view. Fig. 7. Tergum first thoracic segment, same specimen. Side view. Fig. 8. Posterior margin second abdominal segment, same specimen. Figs. 9-11. *Onychiurus butrosi* n. sp. Fig. 9. Side view third antennal segment organ, specimen from Hermel, Lebanon. Length of sensory clubs 4 micra. Fig. 10. Ventral view, same organ and specimen. Fig. 11. P.A.O., same individual. Magnification as above. Figs. 12-15. *Onychiurus fazii* n. sp. Fig. 12. Claw, specimen from Latakia, Syria. External edge unguis 36 micra. Fig. 13. Third antennal segment organ, specimen as above. Organ length 20 micra. Fig. 14. Sensory clubs of third segment organ, another specimen from Latakia. Fig. 15. Sensory clubs as above, specimen from Ain Z'halte, Lebanon.

* Dotted lines in figures 6, 7 and 8 represent limits of variation of setae bases in more variable setae.



CHRISTIANSEN — ONYCHIURUS

great deal. All of the following chaetotaxy formulae are to be found (Gisin, 1952): i1m, i3m, i2—, and i3—. The formula i3m is by far the most common and may be considered typical of the species. The relationship of the M/S setae of the fifth abdominal varies from 17/10 to 19/12, with 18/11 being the commonest form.

The species is distinguished from all others of the *armatus* group by a combination of characters, particularly the presence of 2 pairs of pseudocelli on the posterior borders of the head and fifth abdominal segment, the absence of ventral pseudocelli, and the relationship of M/S.

Type locality: Ain Z'halte Cedars, Lebanon, X-28-53. Also taken from: Vicinity Becharra Cedars, Lebanon, VII-1-52; "The Cedars," elev. 1900 m., Lebanon; Vicinity Bludane, Syria.

Onychiurus armatus Tullberg

Onychiurus armatus Tullberg, 1869, Akad. Afhandl. Uppsaler. Pp. 1-20.

I have found this species from a single locality: Ain Z'halte Cedars, Lebanon. Cassagnau reports it from six localities in Lebanon, but the localities he reports it from make it appear probable that he is including under this name both *armatus* and *O. levantinus*.

Onychiurus octopunctatus Tullberg

Onchiurus octopunctatus Tullberg, 1876, Ofver. Kongl. Vet.-Akad. Forhand. 33:23-42.

Two specimens of this species were reported from Lebanon by Cassagnau.

Onychiurus butrosi n. sp.

Plate 7, Figures 9-11

Description of holotype (male): Color extremely pale yellow; body stout, somewhat swollen posteriorly; last three abdominal segments not clearly separated; head with a number of long, straight or slightly curved setae largely confined to the lateral and posterior portions; first thoracic segment with a single row of setae as described for *O.*

zschokkei;[2] fifth and sixth abdominal segments with a number of very long setae prominent on the sixth, where they make a brush-like cluster at the end; anal horns small and similar in structure to small setae; third antennal sense organ with four slender protective papillae, and a single peg-like sensory rod; two large, flat sensory clubs, irregularly clavate in dorsal (or ventral) view, but slender capitate structures when seen laterally; fourth antennal segment with a small but definite bulb in a subapical pit and 16 large, curved, slightly blunted setae present on the apical part; no ventral organ present; P.A.O. of 18 irregular tubercles arranged in a rough ellipse; claw simple, untoothed with empodial appendage acuminate and reaching about half distance from base to apex of unguis, pseudocellar formula: dorsal surface — 32/122/223320, ventral surface — 1/000/001100.

Variation and Discussion. This species is very similar to *O. zschokkei* in general structure. The chaetotaxy, P.A.O., and general appearance are all similar. It differs in the structure of the third antennal segment sense organ, and the range of variation in the number of lobes of the P.A.O. In the present species this ranges from 14-20, whereas in *zschokkei* it varies from 20-30. There appears to be a great deal of variation in the pseudocelli of *butrosi;* however, it is difficult to determine how much of this is a matter of technical difficulties and how much is real variation. The commonest condition appears to be that described for the holotype. The second thoracic segment may have two and the second abdominal segment one pseudocellus. Abdominal segments three and four occasionally have two pseudocelli on each side of each segment.

Type locality: "The Cedars," Lebanon, elev. 1900 m. Also taken from: American University Campus, Beirut, Lebanon, V-29-52; Barouk Cedars, Lebanon, VI-14-53; Vicinity Bludane, Syria.

Onychiurus fimetarius Linné

Onychiurus fimetarius Linné, 1766, Systema Naturae, ed. 12. 1(2):1013.

Cassagnau reported this species from five localities.

[2] Extracts from a paper upon *O. zscokkei* by H. Gisin now in press.

I did not recover the species even in collections from the same locality. This difference might be due to collection techniques, as I never used the earth washing method, but it appears more likely that there is a difference of identification. In any case the occurrence of this species, as separate from the new forms described in this paper, must be tentative.

Onychiurus archivari n. sp.

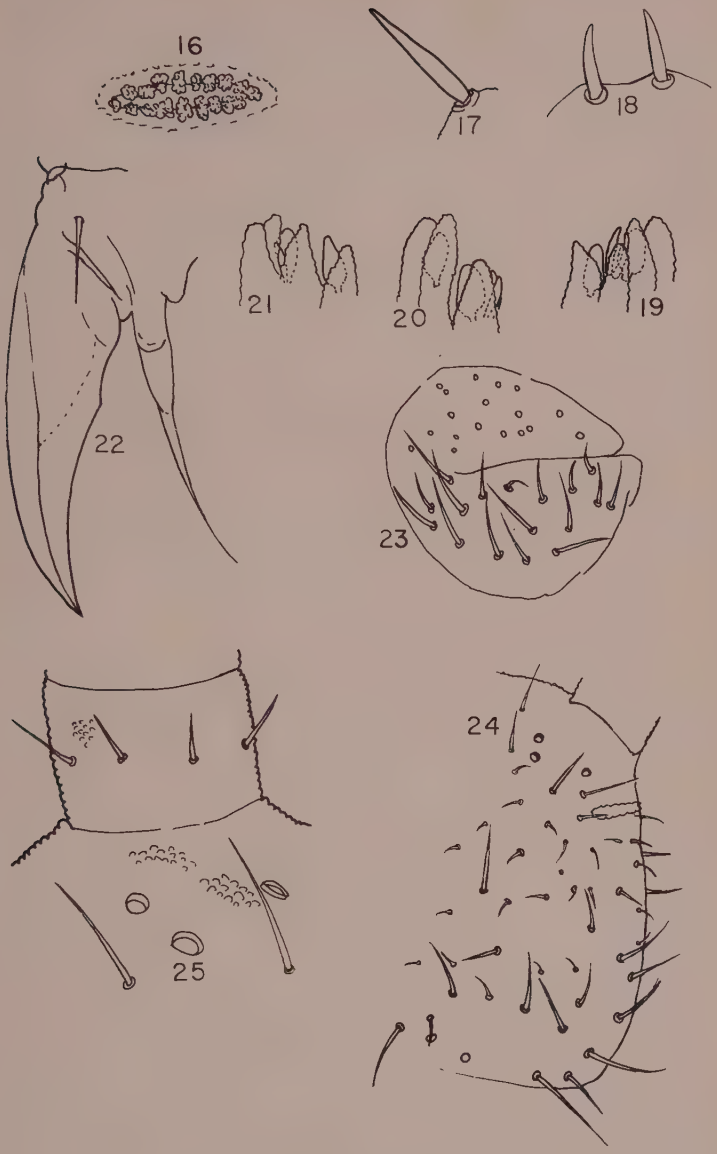
Plate 8, Figures 16-25

Description of holotype (female): Color white; setae on ventral surface of second through fourth abdominal segments very small and numerous; a single large seta on the lateral margin of each thoracic tergite; large setae of dorsal surface becoming larger and more numerous rearward; on fifth and sixth abdominal segments they form double transverse rows; anal horns well developed, about half as long as unguis, slightly curved and situated on very small integumentary rings which have non-confluent bases; pseudocelli equipped with small closing teeth; third antennal sense organ of four slender protective papillae, a pair of slender curved rods, and two smooth pine-tree-shaped sensory knobs; a single small bilobed knob appears on the fourth antennal segment in a deep pit slightly below the apex; ventral surface of fourth antennal segment equipped with numerous small smooth

---

Explanation of Plate 8

Onychiurus archivari n. sp. Fig. 16. P.A.O., specimen from Ain Z'halte Cedars, Lebanon. Organ length 28 micra. Fig. 17. Anal spine of same specimen. Length 20 micra. Fig. 18. Anal spines paratype. Length 19 micra. Fig. 19. Third antennal segment organ, specimen from Ain Z'halte Cedars, Lebanon. Organ length 22 micra. Fig. 20. Third antennal segment organ of paratype. Magnification as above. Fig. 21. Third antennal segment sense organ another paratype. Fig. 22. Left hind claw holotype. External edge unguis 49 micra. Fig. 23. Male genital plate paratype. Organ length 38 micra. Fig. 24. Dorsal surface of head of paratype. Fig. 25. Right antennal base, specimen from Ain Z'halte Cedars, Lebanon.



CHRISTIANSEN — ONYCHIURUS

setae, dorsal surface with many long curved ones, those near the apex somewhat heavier and blunter than the remainder; P.A.O. of 14 complex lobed papillae, arranged in an elongate ellipse; claw untoothed, apical filament of gradually acuminate empodial appendage exceeding level of apex of unguis; integument of antennal bases not clearly distinguishable from that of remainder of head; no furcula remnant visible; pseudocellar formula: 32/123/333330; no ventral pseudocelli seen; bases of coxae each with a pair of pseudocelli.

Variation and Discussion. The sensory knobs of the third antennal sense organ vary from more or less triangular as described to an almost circular shape. Most specimens have triangular or oval organs or some compromise between these. The number of pseudocelli varies a good deal. The condition described for the holotype is that found on the majority of adult specimens. The first three abdominal segments may have four or, rarely, five pseudocelli. The coxal bases often appear to have a single pseudocellus, but this may be due to the structure of this organ which tends to hide the pseudocelli in integumentary folds. The number of lobes in the P.A.O. varies from 12 to 18.

This species is a member of the *ambulans* group and is unique in its absence of ventral pseudocelli. Among the species of this group it appears to be most closely related to *boldorii* and *stillicidii,* but differs from both of these by the complete absence of a ventral organ on the adult males, in addition to the distribution of the pseudocelli.

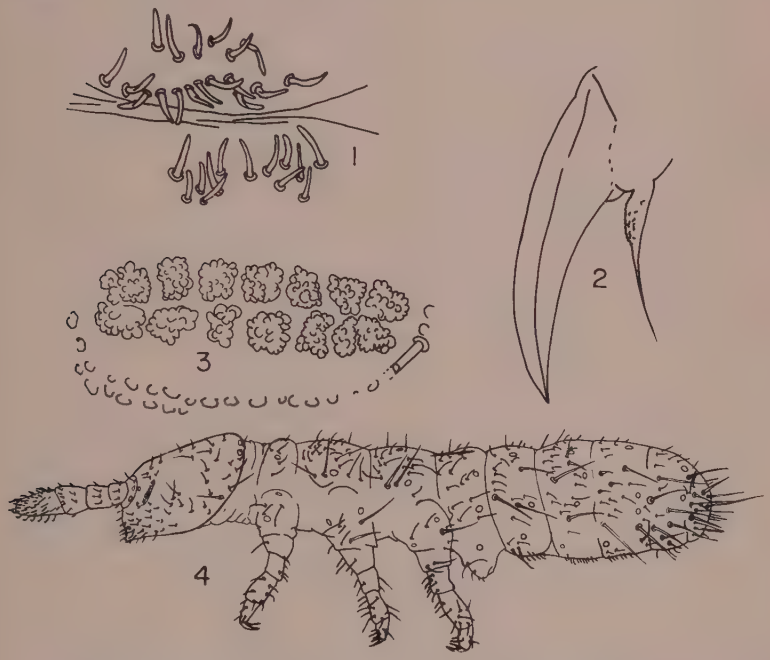
Type locality: Barouk Cedars, Lebanon, VI-14-53, elev. 1700 m. Also taken from: Hadeth Cedars, Lebanon, elev. 1700 m., VII-19-53; Ain Z'halte Cedars, Lebanon.

Cnychiurus fazii n. sp.

Text-figure 1; Plate 7, Figures 12-15

Description of holotype (male): Color pale yellow; body stout, bluntly rounded and expanded posteriorly. For chaetotaxy see figures. Anal horns absent; third antennal segment sense organ with four granulate protective papillae, a pair of subcylindrical rods, and a pair of flat-

tened, ovoid, bifid, sensory knobs; P.A.O. with 16 complex lobed sensory papillae arranged in a narrow ellipse; tubercles of the integument very coarse on head and dorsal surface of body, smaller on antennae with line of demarcation sharp; unguis untoothed; empodial appendage expanded basally but without lamella; filamentous extension of appendage, reaching three-quarters distance from base to apex of unguis; fourth antennal segment without unusually thick setae, but with well developed subapical bulb in a deep pit; pseudocellar formula: dorsal surface — 32/123/333330, ventral surface—0/000/111100; each leg base has a pair of pseudocelli; no clear ventral organ (see discussion below).



Text-figure 1. Characteristic structures of *Onychiurus fazii* n. sp. 1. Male ventral organ, specimen from vic. Sidon, Lebanon. 2. Hind unguis, specimen from Ain Z'halte Cedars, Lebanon, external edge 58 micra. 3. P.A.O., same specimen, length organ 60 micra. 4. Habitus paratype, length 2.4 mm.

Variation and Discussion. This species is one of the most variable known in the genus. At one point I decided that it actually represented two separate species, but further studies showed that the various differential characteristics varied individually from population to population making it impossible to separate out two clear entities. Unfortunately, the samples available at present are small, and any final settlement of the taxonomic status of the several variations seen in this species must await careful analysis of further collections.

The most striking variation concerns the male ventral organ. Some populations lack this entirely even in adult specimens, while other populations have a well developed ventral organ (see figure) consisting of a number of finger-like setae situated around the border of the second and third abdominal segments. In some populations, apparently, adult males exist both with and without this organ. The ventral pseudocelli may be entirely absent, while in a few forms a single pair of ventrals occur on the head. The dorsal surface of the third and fourth abdominal segments may have four pseudocelli, while the leg bases may have only one or one on the first pair and two on the remainder. The apical filament of the empodial appendage may exceed the apex of the unguis or only reach to its middle. The chaetotaxy also varies a great deal, particularly in the posterior parts of the abdomen. It is quite possible that larger series will show this to be a species complex rather than a single variable form.

Type locality: American University Campus, Beirut, Lebanon, X-53. Also taken from: Chamlane, Lebanon, XII-13-53; Ain Z'halte Cedars, Lebanon, XI-2-53; Latakia, Syria, just below Turkish border, VII-2-53.

Metaphorura bipartita Handschin

Metaphorura bipartita Handschin, 1920, Verh. Naturf. Gesel., Basel. 32:1-37.

The specimens of this species appear to be very typical. Cassagnau found it in two places, Jezzine, 6-XI-51, and Sources de Habani, 22-XI-51. I located it in two other places, 14 km. South of Sidon and Ain Z'halte, Lebanon.

Stenaphorura quadrispina Börner

Stenaphorura quadrispina Börner, 1901, Zool. Anz. 24(133):1-15.

The specimens of this form (about 12) all came from a single collection: Ain-Tiffaha (vicinity Quaranita), Lebanon, VII-31-52, elev. 1500 m. They differ from the forms described by Stach by having the anterior horns more than half as long as the posterior pair.

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FLIGHT ACTIVITIES OF THE ANT *DOLICHODERUS (HYPOCLINEA) MARIAE* FOREL[1]

By Mary Talbot

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Often some reference is made to the "flight" of a species of ants as if all the males and females left the colony on one day. W. M. Wheeler, in his 1905 account of the genus *Dolichoderus*,[2] said of *D. mariae*: "August 20 is approximately the date of the nuptial flight of this species." Today it is generally understood that there are usually a number of flights. This study shows that *D. mariae* is conspicuous in this respect.

In 1954 a long series of flights of a colony of *D. mariae* was observed at the Edwin S. George Reserve, Livingston County, Michigan. This colony was a large one, which nested in a blackberry patch (*Rubus allegheniensis* Porter) on a slope facing northwest above Southwest Swamp. The nest had been made by digging out the sandy soil around a blackberry stalk to form a central cavity below ground. Where this was bridged across by roots and stems, great masses of ants rested and placed their brood. Above this they had built a beautifully constructed little igloo, which extended the central cavity aboveground. It was four inches high and seven inches across and was made of dried leaves, small twigs and grass blades, all lightly put together and held in place by the stems which passed through it. Two blackberry stalks and many grass stems (*Poa compressa L.*) extended above it. Entrances were scattered all over the mound but were inconspicuous be-

[1] The work was assisted by a grant from the Edwin S. George Reserve Scholarship Fund. Facilities of the Reserve were made available by Dr. T. H. Hubbell, Acting Director, and Dr. Irving J. Cantrall, Curator of the Reserve.

[2] Wheeler, W. M., 1905. The North American Ants of the Genus *Dolichoderus*. Bull. Amer. Mus. Nat. Hist., 21: 305-319.

cause they were simply openings in the mass of stems and leaves.

The nest was found on August 10, 1954, at 10 o'clock in the morning (Eastern Standard Time), and it was a most interesting sight at that time. The whole mound was completely covered with a milling mass of the vivid red and black workers together with three or four dozen equally bright females. Some workers were foraging, but most seemed to be merely "promenading" in the sun, and a few even carried pupae or larvae about with them. Females seemed to have no urge to climb upward above the mound, and if one started down toward the ground, workers would touch or pull her until she walked up to the top again.

The next day males as well as females were promenading with the workers, and it was suspected that a flight might have taken place earlier that morning. To check this assumption, the colony was observed at 8 a.m. the following day. Although the morning was sunny, the temperature was only 55°F and as a result no ants were in sight. At 9 o'clock (58°) a few workers, males and females, were moving slowly on the mound, and by 9:30 a.m. (58.5°) some were climbing blackberry and grass stems directly above the nest. Workers were touching some of the winged ants on the side or back in a fashion which caused them to move upward, but most climbed with no urging. Some ants fluttered their wings as they walked about, but none flew until 9:45 a.m. (65°) when four females flew at one time. Many males and females had come from the mound and had climbed upward on blackberries or grasses, but no more flew, for by this time the mound was in partial sunshine and the temperature rose abruptly to 74°F. By 9:55 a.m. all had come back down, and there was a mass of winged ants and workers on the mound similar to the one seen the day before. Since this does not constitute a good flight, it is suspected that it was the first of the series.

The flight the next day (August 13) was a typical one with many males and females leaving the colony. At

8:30 a.m. (60°) the mound was covered with ants, and a steady procession of males and females was climbing above the nest. Again, workers seemed to push some from behind. The first male flew at 8:34 a.m. (61°) and was followed by a continuous stream of others. Females kept fluttering their wings but did not begin to fly until 8:55 a.m. (65°). In the meantime, tops of berry leaves and blades of grass became greatly crowded with the winged ants, males predominating over females. As both continued to fly, there came to be more females then males on the berry bushes, for males stopped coming from the nest before females did. By 9:30 a.m. (66°) the last male had flown and there were no more winged ants on the mound, but females continued to fly from plants until 9:50 a.m. (69°). Toward the end of the flight, workers became active again, but this time they tapped winged ants in such a way that the latter moved downward.

From this day, ants continued to fly each morning unless the weather prevented. Eighteen flights were watched in the 27 days between August 12 and September 7. Bad weather prevented flights on four days, and on five days no observations were made. Perhaps flights began before August 12, and they certainly continued after September 7, when observations ceased, because there were still males and females in the colony.

During this time an amazing number of ants flew. It was hard to count flying ants, but estimates were made for numbers leaving the nest per minute at various times during flying. At least 15,000 flew from the colony. Largest flights occurred on August 20 and 22 and September 1 and 5, when an estimated 1550, 4370, 1750, and 1500 flew. Smallest flights were on August 12 (4), August 17 (33) and August 26 (57). On the latter two days the weather was unfavorable. The flight on September 6 (the last complete one observed) released over 900 ants — evidence that numbers had not been greatly depleted at that time.

It soon became apparent that the wide fluctuation of time of day of the flights was determined by temperature

(Table I). After a cold night flying was delayed, but if the night had been warm it began while the morning light was still dim. Ants were not found outside the nest at 55° or lower but could walk on the mound at 56° or 57°. Sometimes they could begin climbing slowly at these temperatures, but usually the migration upward did not start until 59° was reached. Males and females both climbed at these low temperatures, but at first males greatly

Table I. Temperatures at which flight activities occurred for the ant *Dolichoderus mariae* Forel. Edwin S. George Reserve, Livingston County, Michigan. 1954.

		Range	Median
Winged ants began to emerge from nest		56°-58°F	57°F
Winged ants began to climb grasses		56°-61°F	59°F
Beginning of flights			
	male	58°-67°F	60°F
	female	63°-67°F	64°F
End of flights			
	male	63°-71°F	66°F
	female	67°-74°F	69°F

outnumbered females on the leaves. Fortunately, the position of the nest, on a slope facing northwest, kept it in shade during early morning and allowed temperatures to rise slowly enough so that a difference in the reaction of males and females could be distinguished. Males could begin flying as early as 58° but they usually waited until the temperature reached 59° or 60°. Only once did they delay beginning their flight until it was above 64°. That was a morning of dense fog when none flew until 67°. Females never began flying before 63°. When temperatures rose rapidly after a cold night, the two might begin flying at almost the same time, but if temperatures hovered between 58° and 63°, males might fly for 20 or 30 minutes before females began. One overcast morning there was an exclusively male flight because temperatures never rose above 64°, and all of the females walked back down from the vegetation into the nest. The earliest that males began to fly was 5:28 a.m. (67°) and the latest

was 9:23 a.m. (64°). Extremes for beginnings of female flights were 5:30 a.m. (67°) and 10:40 a.m. (64°).

Flights varied greatly in their duration, depending upon how fast the temperature rose. The longest flight lasted from 5:28 a.m. to 8:05 a.m., but it started early in a dense fog, and later, after both males and females were flying, flight was interrupted for an hour because wings became too wet to be used. One of the shortest flights, lasting 32 minutes, was one of the abundant ones. This occurred on September 1 after two days of bad weather, and an estimated 1750 ants flew. It was a sunny morning and the temperature rose very rapidly from 9:03 a.m. (58.5°) to 9:35 a.m. (72°). On this day males flew for 22 minutes from 9:03 a.m. to 9:25 a.m. (69°) and females for 21 minutes from 9:14 a.m. (63.5°) to 9:35 a.m.

The ending of flights varied greatly as to time. Males have stopped flying as early as 6 a.m. or continued as late as 9:45 a.m.; females as early as 6:25 a.m. or as late as 10:45 a.m. Flights could be stopped by rising temperature; no males were seen to fly at temperatures above 71° nor females above 74°. But often flights ended well below these temperatures. On the four days when the most ants flew, flights stopped at the following temperatures: August 20 — males 64°, females 67°; August 22 — males 66°, females 67°; September 1 — males 69°, females 72°; September 5 — males 70°, females 70°. Perhaps on fine mornings all those which were mature flew before the critical temperature was reached. Sometimes practically all those which climbed vegetation flew; yet at other times many returned to the nest. It seems probable that *D. mariae* flights began shortly after the first winged ants emerged from the pupal stage, and flights continued as others emerged. Darkening sky and lowering temperature could end flights, and on these days many males and females returned to the nest.

Flights were prevented on two days by rain, and on two others, apparently, by high winds. On these latter days, males and females were slow about climbing and

after standing about for a while, returned to the nest even though temperatures were favorable.

Workers took an interesting part in flight. During the first days when females were walking on the mound, workers paid no attention to them unless they tried to walk down off the nest. Soon the urge to go upward became well-developed in males and females, and most of them climbed plants directly above the mound without urging. However, workers climbed grass blades and touched some from behind in such a way that they moved upward. In contrast, when flights were slowing for the day, or when weather became adverse, workers became very active in patrolling grasses and touching, or perhaps biting, males and females in a way that induced them to walk downward. Occasionally a worker carried a male, holding it by the dorsal side of the petiole so that the male was upright and to one side of the carrier. More rarely females would be carried, but usually they were simply "herded" down. Often a great many workers would patrol mound and grasses after a flight. Apparently they did not contact winged ants by sight because, if a male moved out of touch, workers walked about at random until they touched it again. Sometimes workers cooperated — three were seen hunting one male, and four worked together to pull a female down a stem. Only once did workers try to prevent a flight. On September 4 at 7 a.m. (59°) for about five minutes, they prevented the males and females from climbing until they pushed their way above the ring of workers on berry stems and grasses and succeeded in having a weak flight.

Spiders profited by flights. On five occasions a spider was seen to capture a male and carry it away, and occasionally a male would fly into a small web attached to grasses near the nest.

VEROMESSOR LOBOGNATHUS IN NORTH DAKOTA (HYMENOPTERA: FORMICIDAE)[1]

By George C. Wheeler and Jeanette Wheeler
Department of Biology, University of North Dakota

In our field studies on the ants of North Dakota we have been in the habit of identifying our collections of *Pogonomyrmex* by casual inspection with the unaided eye. This seemed adequate, since there is only one species of this genus in the state and since we knew of no other ant that could be confused with *Pogonomyrmex*. But after reading Gregg's interesting paper[2] on *Veromessor* we hurriedly re-examined our material under magnification. (See Fig. 1.). Among a hundred nest-series of putative *Pogonomyrmex occidentalis* (Cresson) we discovered one of *Veromessor lobognathus* (Andrews). This is only the sixth collection of this species, but it extends the range northward by 450 miles. Since almost nothing is known about its habits and ecology we hoped that our field notes would contribute something, but we found them disappointingly laconic: "Under flat rock 32 x 2) x 2" lying on north wall of east-west valley. ATYPICAL." The word "atypical" is significant for it shows that at the time we regarded the ant as *P. occidentalis* and a *Pogonomyrmex* nest under a rock was something we had never seen. Our error was not detected until the autumn or winter of 1955. Consequently we could not return to the site until the summer of 1956. By that time southwestern North Dakota had suffered a year of drouth and ants (except *P. occidentalis*) were scarce and hard to find. We revisited the same hillside and literally "left no stone unturned"; in fact we turned them over twice — the second time after the late summer rains. But we found no trace of the

[1] This study was aided by a grant from the Louis W. and Maud Hill Foundation.

[2] Gregg, R. E. 1955. The rediscovery of Veromessor lobognathus (Andrews) (Hymenoptera: Formicidae). Psyche 62: 45-52.

coveted *Veromessor*. If moisture conditions improve, we plan to resume our search next summer.

The Locality

Billings County, North Dakota. T. 140 N., R. 102 W., sec. 1. On an ordinary map it can be located four miles north-northeast of Medora, in Roosevelt National Memorial Park (South Unit). The site is in the heart of the Little Missouri Badlands. June 12, 1954. Collected by G. C. and J. Wheeler, No. 556. Altitude approximately 2500 feet above sea level.

Habitat

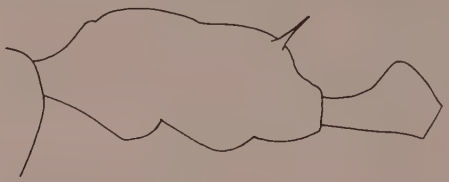
The nest was discovered in a tributary valley entering the valley of the Little Missouri River from the east. This tributary valley is short, narrow, steep-walled and about 200 feet deep at the mouth. At the bottom is a small intermittent stream with little or no flood plain. The soil is a sandy silty loam.

The south wall of the tributary valley is densely covered with a thicket of Rocky Mountain red cedar (*Juniperus scopulorum* Sarg.). The thicket floor is covered with duff and moss and is relatively humid.

In marked contrast, the nearby north wall — as the result of greater insolation — is treeless and sparsely beset with grass and low shrubs, such as sagebrush (*Artemisia frigida* Willd. and *A. tridentata* Nutt.), saltbushes (*Atriplex* spp.) and rabbitbrush (*Chrysothamnus graveolens* Nutt.). Yucca (*Yucca glauca* Nutt.) and prickly pear (*Opuntia polycantha* Haw.) are present but very scarce. The most abundant and conspicuous ant is the western harvester (*Pogonomyrmex occidentalis*). Scorpions (*Vejovis boreus* Girard) are common under rocks.

Our colony of *Veromessor lobognathus* was found under a rock halfway up the north wall. Its occurrence on a slope with southern exposure is significant in interpreting the distribution of this species, i.e., why a southwestern species occurs so far to the north. "The Upper Austral Zone, the Upper Sonoran, or semiarid subdivision of which penetrates only into the warmest corners of the

State, is in no part sufficiently extensive to be marked by entirely characteristic mammals, birds, or plants. In its narrow strips along the Missouri Valley below Bismarck, down the Missouri and Yellowstone Valleys to Williston, along the Little Missouri Valley above the Killdeer Mountains, and on many dry, warm slopes between these



A

B

Text figure 1. Thoracic profiles of (A) *Pogonomyrmex occidentalis* (Cresson) and (B) *Veromessor lobognathus* (Andrews), both x8.8.

areas, it is strongly characterized. So near the edge of a zone, however, the slight inclination of a slope to the north reduces the heat received from the sun's rays sufficiently to change the flora and fauna in part or wholly to that of the colder, higher zone, while a steep slope facing the direct rays of the sun will attract many species of the warmer, lower zone above their normal limits."[3]

The Larva

Genus VEROMESSOR Forel

Body curved ventrally, thorax only moderately stout. Body hairs sparse and short; of three types: (1) the shortest and most numerous, tip simple or bifid; (2) longer,

[3] Bailey, Vernon. 1926. A biological survey of North Dakota. U.S. Dept. Agric., Bureau of Biol. Survey, North American Fauna, No. 49. p. 8.

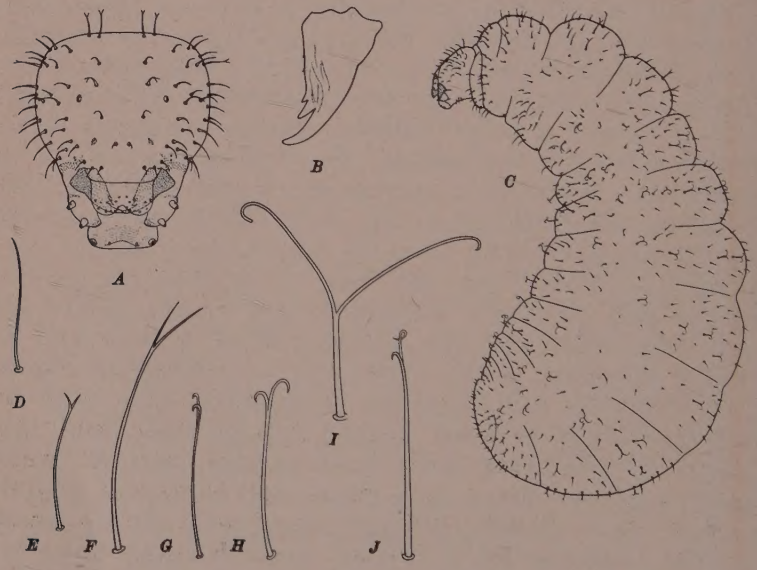
with the tip bifid; (3) also longer, bifid, the branches short to long and recurved at the tip. Antennae minute. Head hairs moderately numerous, short, with the tip simple or bifid. Mandibles with the apex forming a long large round-pointed tooth which is curved medially; the two medial teeth prominent and round-pointed; a few spinules on the medial surface. Maxillae with the apex spinulose. Labium moderately spinulose. Dorsal portion of hypopharynx with sublongitudinal ridges; ventral portion spinulose, the spinules minute and in numerous subtransverse rows.

Veromessor lobognathus (Andrews)

(Text figure 2)

Body length (through spiracles) about 6.8 mm. Stout; diameter greatest at abdominal somite V, diminishing gradually to the anterior end and rapidly to the posterior end, which is broadly rounded. Whole body curved ventrally. Anus ventral. Lateral longitudinal welts present. Leg, wing and gonopod vestiges present. Spiracles small; the mesothoracic the largest. No spinules seen on the integument. Body hairs sparse, short and uniformly distributed. Of three types: (1) 0.036-0.094 mm long, with the tip simple or bifid, on every somite, the most abundant type; (2) 0.094-0.156 mm long, with bifid tip, on the thorax and abdominal somites IX and X; (3) 0.078-0.156 mm long, bifid, with the branches short to long and recurved at the tip, on the metathorax and abdominal somites I-IX. Cranium subrectangular in anterior view, with the occipital angles rounded, slightly broader than long. Antennae minute, each with three sensilla, each of which bears a spinule. Head hairs moderately numerous, slightly curved; short (0.036-0.086 mm long), with the tip simple or bifid. Labrum small, bilobed, breadth nearly twice the length; anterior surface of each lobe with 10 sensilla; ventral border with a few minute spinules; posterior surface spinulose, the spinules minute and in short arcuate rows, the rows transverse dorsally and longitudinal ventrolaterally; posterior surface with two isolated sensilla

and a cluster of three sensilla on each lobe. Mandibles rather small; heavily sclerotized; subtriangular in anterior view; the apex forming a long, rather large tooth which is curved medially; medial surface with two rather large round-pointed teeth on the distal half and a few ridges bearing spinules on the proximal half; anterior surface with a few longitudinal ridges. Maxillae with the apex spinulose, the spinules minute and in short arcuate rows; palp paxilliform with one lateral sensillum (bearing a spinule) and four apical (two small and bearing a spinule each and two larger and encapsulated) sensilla; galea digitiform, with two apical sensilla. Labium with the anterior surface spinulose, the spinules minute and arranged in short transverse rows; palp a boss with five apical sensilla; an isolated sensillum between each palp



Text figure 2. Larva of *Veromessor lobognathus* (Andrews). A, head in anterior view, x47; B, left mandible in anterior view, x117; C, larva in side view, x14; D and E, type 1 body hairs, x217; F, type 2 body hair, x217; G and H, type 3 body hairs (with short branches) in side and surface views, x217; I and J, type 3 body hairs (with long branches) in surface and side views, x217.

and the opening of the sericteries; the latter a short transverse slit in an anteroventral depression. Dorsal portion of the hypopharynx with sublongitudinal ridges, ventral portion spinulose, the spinules minute and in numerous subtransverse rows. (Material studied: six larvae from the nest cited above.)

Since this is our only representative of the genus we do not know whether it differs as much from its congeners as does its adult. It does, however, resemble the larva of the closely related genus *Novomessor*.

THE SYNONYMY AND RELATIONSHIPS OF THE ANT PSEUDOLASIUS BAYONI MENOZZI. — The synonymy is as follows:

Pseudolasius Bayonii Menozzi, 1924, Ann. Mus. Civ. Stor. Nat. Genova, 51:224, figs. 5, 6, worker max. Type loc.: Bugala, Sesse I., Victoria Nyanza.

Pseudolasius bayoni, Menozzi, 1932, *ibid.,* 56:115, worker min. from type collection.

Pseudolasius myersi Weber, 1943, Bull. Mus. Comp. Zool., 93:389, pl. 16, fig. 35, worker. Type loc.: Lotti Forest, w. slope Imatong Mts., Equatoria, Sudan. **New synonymy.**

Pseudolasius myersi occipitalis Weber, 1950, Amer. Mus. Novit., 1443:2; figs. 1-18, workers max., min., larva, egg, polymorphism, biology. Type loc.: Busnia, Uganda. **New synonymy.**

When Weber described *myersi* and *occipitalis,* he was unaware of Menozzi's *bayoni* descriptions of 1924 and 1932, as is shown by his omission of this name from his list of the African *Pseudolasius.* Two minor workers from the *bayoni* type nest series have now been compared with two syntypes of *myersi* in the Museum of Comparative Zoology, and agreement is good. The race *occipitalis* appears from the description to be nothing more than the major worker of the same species. *P. bayoni* normally has six mandibular teeth counting the large apical tooth. Menozzi counted five teeth, but may have excluded the apical. Some specimens, especially in a series from near Epulu, Belgian Congo (T. Gregg), tend to have a small seventh offset tooth developed near the basal angle. The related *P. gowdeyi* Wheeler is larger and usually has five mandibular teeth, although occasionally a minute sixth intercalary or basal tooth is present. — W. L. BROWN, JR., Museum of Comparative Zoology, Harvard University.